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PATENT ABSTRACTS OF JAPAN

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(54) WOVEN FABRIC OF PITCH-BASED CARBON FIBER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a woven fabric of a pitch-based carbon fiber suitable as a raw material for CFRP and C/C having high strength.
SOLUTION: The objective woven fabric of a pitch-based carbon fiber has an FAW of 50-500 g/m2 and a mesh opening ratio of ≤10%.

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CLAIMS

[Claim(s)]
[Claim 1] Pitch-based-carbon-fiber textiles with which FAW is characterized by 50-500g/m2, and an opening rate being 10% or less.
[Claim 2] Pitch-based-carbon-fiber textiles of the claim 1 which comes to carry out the weaving of the pitch based carbon fiber of 8000 filament - 20000 **s.
[Claim 3] The claim 1 or 2 pitch-based-carbon-fiber textiles which come to carry out the weaving of the pitch-based-carbon-fiber tow whose **** fineness is 1.0-3.0g/m, and is 10-40mm.
[Claim 4] The prepreg which comes to sink into one pitch-based-carbon-fiber textiles of the claims 1-3 in thermosetting resin.
[Claim 5] The carbon-fiber-reinforced-plastics composite or carbon fiber strengthening graphite composite manufactured using the prepreg of a claim 4.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the pitch-based-carbon-fiber textiles which have the function which was excellent as composite material.
[0002]
[Description of the Prior Art] Although the pitch based carbon fiber which uses as a raw material PAN system carbon fiber to which a carbon fiber uses a polyacrylonitrile (PAN) as a raw material, and pitches is manufactured now, especially a pitch based carbon fiber has the characteristic feature of being a high elasticity, and more extensive intended use is expected. Such a pitch based carbon fiber is being used as an aeronautics-and-astronautics intended-use various structural material from a sport and a leisure supply. In this case, a carbon fiber is made into the intermediate field called prepreg which thermosetting resin was infiltrated into the textiles which carried out the weaving of the tow and obtained it, and was processed into them in the shape of a sheet. The carbon-fiber-reinforced-plastics composite which cast this prepreg and was stiffened (henceforth "CFRP"), Or it is common to infiltrate a pitch and thermosetting resin and to use this prepreg as composites, such as baking and a carbon fiber strengthening graphite composite (henceforth "C/C") made to make it precise.
[0003] In order to make the use domain of a composite which consists of these carbon fibers expand further, performance enhancement and a cost cut of a carbon fiber, carbon fiber textiles, etc. of an interval base material are a big technical probrem besides technical enhancement of composite-izing. First, a carbon fiber can lower a cost by enlarging fineness of a carbon fiber tow. That is, by making the diameter of fiber thick or making [many] the number of filaments, fineness becomes large, and the productivity in a spinning process or a baking process improves, and it is enabled to manufacture a cheap carbon fiber tow. However, generally, the carbon fiber textiles which used the thick carbon fiber tow have large FAW (weight per unit area of Fiber Area Weight:textiles) and thickness of textiles, the resin impregnating ability when casting a prepreg becomes bad, its void of the resin in the composite obtained using it increases, and a high strength property can seldom expect them. With the parvus carbon fiber textiles of FAW which, on the other hand, used the thick carbon fiber tow, since the opening formed between carbon fiber tows becomes large, the content of the carbon fiber of the composite obtained using this has the problem that the void of a resin occurs intensively in the opening fraction which becomes low and is formed between carbon fiber tows.
[0004]
[Problem(s) to be Solved by the Invention] Therefore, a thick carbon fiber tow is used and the small carbon fiber textiles of FAW of the thickness with an opening thin uniformly [it is few and] are ideal. For that purpose, it is difficult to open a thick carbon fiber tow, for fiber to tend to break with the carbon fiber of a pitch system for the characteristic feature of being a high elasticity, although it is necessary to make **** large and it needs to carry out a weaving, and to fully open a tow. Moreover, even if it could open, when the weaving was carried out using the carbon fiber, and an opening rate was large in addition, or produced a defect by fracture of the single fiber produced by the incurvation at the time of a weaving, friction, etc., the fluff, etc. and applied these textiles to a composite, the mechanical property of original of a pitch based carbon fiber has not fully been discovered.
[0005]
[Means for Solving the Problem] Then, this invention person etc. examined zealously technique of obtaining the textiles of the outstanding performance which does not have the defect in which an opening is small, using the pitch-based-carbon-fiber tow of a high elasticity. Consequently, when the surface state of a thread guide and the bar along which yarn passes is improved, the carbon fiber tow which can fully demonstrate the mechanical strength of fiber was obtained even if it opens it as much as possible to yarn, as a damage is not given, and the carbon fiber tow was opened further and carried out a weaving in the phase of manufacturing a carbon fiber tow, it found out that the textiles without the parvus of an opening and a defect could be obtained. Furthermore, it found out that there were few defects, and had sufficient intensity, and the composites of a split, such as C [CFRP and]/C, were obtained using these textiles. That is, this invention relates the pitch-based-carbon-fiber textiles with which FAW is characterized by 50-500g/m2, and an opening rate being 10% or less, and it to a composite.
[0006]
[Embodiments of the Invention] Hereafter, this invention is explained in detail. Generally the pitch based carbon fiber which constitutes the pitch-based-carbon-fiber textiles of this invention is manufactured by the following technique. Although the heavy oil of the coal tar of a coal system, a coal tar pitch, a liquefaction-of-coal object, a liquefaction-of-coal object, and a petroleum system, tar, a pitch or naphthalene, the polymerization resultant by the catalytic reaction of an anthracene, etc. are mentioned, for example as a carbonaceous raw material for obtaining the spinning pitch for obtaining a carbon fiber, the spinning pitch with the higher rate of an optical anisotropic texture is desirable. such a spinning pitch to the number of filaments — usually — 8000-20000 — desirable — 8500-18000 — the pitch fiber tow of 9000-16000 is obtained especially preferably An amount producible since the number of books of the tow which can be manufactured at once is restricted when manufacturing this carbon fiber tow, if fewer than 8000 filaments decreases, and it becomes disadvantageous in cost, and on the other hand, since the original tow is also thick when manufacturing the small textiles of FAW from a carbon fiber tow which exceeds 20000 filaments, it becomes still thick by the filamentation and is hard coming to deal with it.
[0007] Next, a non-deliquescent fiber tow is obtained by usually heat-treating this pitch fiber tow at 300-400 degrees C in the oxidizing gas ambient atmosphere. Furthermore, after usually carbonizing and graphitizing this

non-deliquescent fiber tow at 2000-3000 degrees C among the inert gas ambient atmosphere, such as nitrogen and an argon, and carrying out surface treatment by usual technique, a sizing agent is usually preferably installed 0.5 to 7% of the weight 0.2 to 10% of the weight to fiber, and a carbon fiber tow is obtained. As a sizing agent, the arbitrary things usually used can be used and, specifically, an epoxy compound, a water-soluble polyamide compound, a saturation or a unsaturated polyester, vinyl acetate, etc. are mentioned.
[0008] Moreover, although a harness cord is performed in each processes in the above, such as non-deliquesce, and carbonization, graphitization, it is brittle, and is easy to damage weakly to bending, and a fiber tow is damaged, and fiber has the problem which fluff and the thread breakage produce. Then, the bar and COM which are used when bending yarn, in order not to carry out the manufacturing process from the former as it is, but to be able to bend yarn, or for yarn to prevent from rubbing with equipment or yarn as much as possible and to change the sense of yarn unavoidably, when manufacturing the carbon fiber used by this invention adjust a surface state by crepe processing etc., and it is necessary to be made not to give a damage to yarn as much as possible.
[0009] In addition, although it usually has the shape of a cylindrical shape of the flat package type without a V groove or U slot, especially when manufacturing the carbon fiber used by this invention, a front face is crepe-like, and the bar used for a manufacture of a carbon fiber is surface-roughness Rmax. What is about 1-10 micrometers is desirable. Since the touch area of a fiber tow and a bar becomes to some extent small and coefficient of friction becomes small by this, contact tension can be reduced. Conventionally, as the surface-finish technique of a bar, although mirror-plane finishing other than satin finish is common, since the touch area with a thread increases and coefficient of friction becomes large, it is not so desirable in mirror-plane finishing.
[0010] Thus, 1.0-3.0g /of the fineness of the obtained carbon fiber tow is [m] usually 1.1-2.7g/m preferably. If larger in 3.0g /than m, since it is the same as that of the number of filaments, and it becomes as more disadvantageous [as the parvus / in cost] in 1.0g /than m, and a tow will become thick, it becomes still thick by the filamentation and is hard coming to deal with it. Moreover, **** is 10-40mm usually especially prepared to 20-40mm preferably 16-40mm by opening this carbon fiber tow by the conventional method. above also in the case of this filamentation, in order not to give a damage to fiber as much as possible — what — it is desirable to use the opening bar which carried out satin finish furthermore, opened carbon fiber tow the weaving machine which can usually be used in case the weaving of the carbon fiber is carried out, for example, the Chateauroux machine, and a rapier — a weaving is carried out using a weaving machine etc. and it considers as the textiles of plain weave or a satin
[0011] the pitch-based-carbon-fiber textiles of this invention obtained as mentioned above — FAW — 50-500g/m2 — desirable — 80-400g/m2 — especially — desirable — 100-300g/m2 it is — an opening rate is 3% or less especially preferably 5% or less preferably 10% or less In addition, the opening rate of textiles here is an opening between the tows of a carbon fiber tow and tows which carried out the weaving when seeing textiles perpendicularly to the flat surface of these textiles, and is a rate of the fraction with which it passed and the opening between orientation and the opening between latitudinal directions lapped.
[0012]
[Example] Hereafter, although an example explains this invention still in detail, it is not limited by the following examples unless the summary is exceeded. In addition, measurement of the opening rate of the textiles in an example performed the image processing by LUZEXby NIKON CORP.2D, and it asked for it. The picture image of the textiles which are going to measure an opening rate is specifically incorporated, and the rate of the area of the fraction which is opening scale division over a fixed area with textiles is searched for. Since the color tones of the fraction with which scale division are choked up, and the fraction which is opening scale division differ when the picture image of textiles is incorporated, a rate can be searched for easily.
[0013] From example 1 coal tar pitch, the spinning pitch the softening point of 300 degrees C and whose optical-anisotropy rate observed by 100 times under the deflection microscope are 100% was adjusted. this pitch — a mouthpiece — the melt spinning was carried out at the temperature of 335 degrees C, and the pitch fiber tow with 12000 obtained filaments was obtained The non-deliquescent fiber tow was obtained by heat-treating this pitch fiber tow in air at 385 degrees C. Furthermore, after it graphitized this non-deliquescent fiber to the guide bar and COM which carried out crepe processing at 2100 degrees C with through and it carried out surface treatment to them, the sizing agent of an epoxy system was installed 2%, and the carbon fiber tow was obtained. The carbon fiber tow fineness obtained in this way was 2.0g /and 7mm of ****s m.
[0014] the carbon fiber tow opened using the opening bar which carried out crepe processing of this carbon fiber tow so that it might become 20mm of ****s — a rapier — the carbon fiber textiles of the plain weave obtained as a result of carrying out a weaving with a weaving machine were the things without FAW200g/m2, 2% of opening rates, and a defect After having sunk the epoxy resin into these carbon fiber textiles and creating a prepreg, when the laminating was carried out, and heat treatment was carried out for 2 hours, it fabricated at 120 degrees C and CFRP was manufactured, there is no defect and CFRP with intensity with as sufficient about 40kg/mm as 2 in tensile strength has been manufactured. Moreover, it cast and the molding field was acquired, after having sunk phenol resin into these carbon fiber textiles and creating a prepreg. After calcinating this molding field at 2000 degrees C, the precise-ized process which sinks in and calcinates a pitch at 900 degrees C for 1 hour was repeated 7 times. When C/C was manufactured by calcinating this at 2000 degrees C, C/C with the good intensity was obtained that there is nothing of having a big void.
[0015] The weaving was carried out, without opening the same carbon fiber tow as example of comparison 1 example 1, and the textiles of the plain weave of FAW200g/m2, and 50% of opening rates were obtained. Although CFRP was manufactured using these carbon fiber textiles, the big opening was made and it was the tensile strength which is a quadrant grade of CFRP of an example 1.
[0016] The weaving was carried out, without opening the same carbon fiber tow as example of comparison 2 example 1, and the textiles of the plain weave of FAW540g/m2, and 10% of opening rates were obtained. Although the manufacture was tried for CFRP using these carbon fiber textiles, resin sinking in did not work.
[0017] At the graphitization process of example of comparison 3 example 1, the carbon fiber tow manufactured by the same technique as an example 1 was obtained except having used the bar of a mirror plane instead of the crepe bar. When opening processing of this thing was carried out, the weaving was difficult by occurrence of fluff, and the filament piece.
[0018]
[Effect of the Invention] Since the weaving of the pitch-based-carbon-fiber textiles of this invention is carried out

using the thick large carbon fiber tow of ****, they have little irregularity, they have the characteristic feature that no opening between weaving yarn is almost, and can manufacture it cheaply. By using such carbon fiber textiles, there are few defects and the composites which have a very high strength property, such as CFRP and C/C, can be obtained. As concrete intended use of this composite, it is the point of, for example, having the outstanding gas permeability, electrical conductivity, and a mechanical strength, and the application as carbon-electrode material for fuel cells can be expected.

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(54)【発明の名称】　ピッチ系炭素繊維織物

(57)【要約】
【課題】　高強度のＣＦＲＰやＣ／Ｃの原料として好適なピッチ系炭素繊維織物を得る。
【解決手段】　ＦＡＷが５０～５００ｇ／ｍ²、目開き割合が１０％以下であることを特徴とするピッチ系炭素繊維織物。

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【特許請求の範囲】

【請求項１】　ＦＡＷが５０～５００ｇ／ｍ²、目開き割合が１０％以下であることを特徴とするピッチ系炭素繊維織物。

【請求項２】　フィラメント数８０００～２００００のピッチ系炭素繊維を製織してなる請求項１のピッチ系炭素繊維織物。

【請求項３】　繊度が１．０～３．０ｇ／ｍ、糸幅が１０～４０ｍｍのピッチ系炭素繊維トウを製織してなる請求項１又は２のピッチ系炭素繊維織物。

【請求項４】　請求項１～３のいずれかのピッチ系炭素繊維織物に熱硬化性樹脂を含浸してなるプリプレグ。

【請求項５】　請求項４のプリプレグを用いて製造した炭素繊維強化樹脂複合材又は炭素繊維強化炭素複合材。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、複合材料として優れた機能を有するピッチ系炭素繊維織物に関する。

【０００２】

【従来の技術】現在、炭素繊維はポリアクリロニトリル（ＰＡＮ）を原料とするＰＡＮ系炭素繊維とピッチ類を原料とするピッチ系炭素繊維が製造されているが、このうち、ピッチ系炭素繊維は特に高弾性であるという特徴を有し、より広範な用途が期待されている。かかるピッチ系炭素繊維はスポーツ、レジャー用品から宇宙航空用途種々の構造材料として利用されつつある。この場合、炭素繊維は、トウを製織して得た織物に熱硬化性樹脂を含浸させてシート状に加工したプリプレグと呼ばれる中間体とし、このプリプレグを成型、硬化させた炭素繊維強化樹脂複合材（以下「ＣＦＲＰ」という）、あるいは、このプリプレグをピッチや熱硬化性樹脂に含浸させて焼成、緻密化させた炭素繊維強化炭素複合材（以下「Ｃ／Ｃ」という）などの複合材として用いることが一般的である。

【０００３】これらの炭素繊維からなる複合材の使用範囲を更に拡大させるためには、複合化の技術改良の他に、炭素繊維や炭素繊維織物等の中間基材の性能改良やコストダウンが大きな課題である。まず、炭素繊維は、炭素繊維トウの繊度を大きくすることにより、コストを下げることができる。即ち、繊維径を太くしたり、フィラメント数を多くすることにより繊度が大きくなり、紡糸工程や焼成工程での生産性が向上し、安価な炭素繊維トウを製造することが可能となる。しかしながら、太い炭素繊維トウを使用した炭素繊維織物は、一般的に、織物のＦＡＷ（Ｆｉｂｅｒ　Ａｒｅａ　Ｗｅｉｇｈｔ：織物の単位面積当たりの重さ）や厚みが大きく、プリプレグを成型するときの樹脂含浸性が悪くなり、それを用いて得られる複合材における樹脂のボイドが多くなり、高い強度特性があまり期待できない。一方、太い炭素繊維トウを使用したＦＡＷの小さい炭素繊維織物では、炭素

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繊維トウの間に形成される空隙が大きくなるので、これを用いて得られる複合材の炭素繊維の含有率は低くなり、また、炭素繊維トウの間に形成される空隙部分に樹脂のボイドが集中的に発生するという問題がある。

【０００４】

【発明が解決しようとする課題】従って、太い炭素繊維トウを使用して、空隙が少なく均一で、且つ、薄い厚さのＦＡＷの小さな炭素繊維織物が理想的である。そのためには、太い炭素繊維トウを開繊して糸幅を広くして製織する必要があるが、ピッチ系の炭素繊維では、高弾性であるという特徴のため繊維が折れやすく、トウを十分に開繊することが難しい。また、開繊できても、その炭素繊維を用いて製織すると、目開き割合がなお大きかったり、製織時の屈曲、摩擦等により生じた単繊維の破断、毛羽等により欠陥を生じ、該織物を複合材に適用した場合に、ピッチ系炭素繊維の本来の機械的特性を十分に発現できなかった。

【０００５】

【課題を解決するための手段】そこで、本発明者等は、高弾性のピッチ系炭素繊維トウを用いて目開きの小さな、欠陥のない優れた性能の織物を得る方法について鋭意検討を行った。その結果、炭素繊維トウを製造する段階で、糸道や、糸の通るバーの表面状態を改良し、糸にできるだけダメージを与えないようにして、開繊しても繊維の機械的強度を十分に発揮できる炭素繊維トウを得、その炭素繊維トウを更に開繊し、製織することにより目開きの小さい、欠陥の無い織物を得られることを見いだした。更に、この織物を用いて、欠陥が少なく、十分な強度を有し、且つ、薄物のＣＦＲＰ、Ｃ／Ｃなどの複合材が得られることを見い出した。即ち、本発明は、ＦＡＷが５０～５００ｇ／ｍ²、目開き割合が１０％以下であることを特徴とするピッチ系炭素繊維織物、及びそれを複合材に関する。

【０００６】

【発明の実施の形態】以下、本発明を詳細に説明する。本発明のピッチ系炭素繊維織物を構成するピッチ系炭素繊維は一般に以下のような方法で製造する。炭素繊維を得るための紡糸ピッチを得るための炭素質原料としては、例えば、石炭系のコールタール、コールタールピッチ、石炭液化物、石炭液化物、石油系の重質油、タール、ピッチ又はナフタレンやアントラセンの触媒反応による重合反応生成物等が挙げられるが、光学的異方性組織の割合がより高い紡糸ピッチが望ましい。かかる紡糸ピッチから、フィラメント数が、通常８０００～２００００、好ましくは8.５００～１８０００、特に好ましくは９０００～１６０００のピッチ繊維トウを得る。この炭素繊維トウを製造する上では、一度に製造できるトウの本数が限られていることから、８０００フィラメントよりも少ないと、生産できる量が少なくなり、コスト的に不利となり、一方、２００００フィラメントを越える

ような炭素繊維トウからＦＡＷの小さな織物を製造する場合は、元のトウも太いため、開繊によりさらに太くなり、取り扱いにくくなる。

【０００７】次に、このピッチ繊維トウは、を酸化性ガス雰囲気中で通常３００～４００℃で加熱処理することにより、不融化繊維トウを得る。更に、この不融化繊維トウを窒素、アルゴン等の不活性ガス雰囲気中、通常２０００～３０００℃で炭化、黒鉛化し、通常の方法で表面処理したのち、サイジング剤を繊維に対し、通常０．２～１０重量%、好ましくは０．５～７重量%添着し、炭素繊維トウを得る。サイジング剤としては通常用いられる任意のものが使用でき、具体的には、エポキシ化合物、水溶性ポリアミド化合物、飽和又は不飽和ポリエステル、酢酸ビニル等が挙げられる。

【０００８】また、上記における不融化、炭化・黒鉛化等の各工程においては通糸を行なわれるが、繊維は脆弱で折り曲げに対して弱く破損し易く、また、繊維トウが損傷し、ケバや糸切れが生じる問題がある。そこで、本発明で用いる炭素繊維を製造する場合は、従来からの製造工程をそのまま実施するのではなく、できるだけ、糸を折り曲げたり、糸が装置あるいは糸同士でこすれたりしないようにし、また、やむを得ず糸の向きを変えるため糸を曲げるときにおいても使用するバーやコムは梨地処理等により表面状態を調整し、できるだけ糸にダメージを与えないようにすることが必要となる。

【０００９】なお、炭素繊維の製造に使用されるバーは、通常、Ｖ溝やＵ溝のない平型の円筒形状を有するものであるが、本発明で用いる炭素繊維を製造する場合は、特に、表面が梨地状であって、表面粗度Ｒmax が１～１０μｍ程度のものが好ましい。これにより、繊維トウとバーとの接触面積がある程度小さくなり摩擦係数が小さくなるため、接触張力を低減することができる。従来、バーの表面仕上げ方法としては、梨地仕上げのほかに鏡面仕上げが一般的であるが、鏡面仕上げの場合は糸束との接触面積が増大して摩擦係数が大きくなるためあまり好ましくない。

【００１０】このようにして得られた炭素繊維トウの繊度は、通常１．０～３．０ｇ／ｍ、好ましくは１．１～２．７ｇ／ｍである。フィラメント数と同じで、１．０ｇ／ｍより小さいとコスト的に不利となり、３．０ｇ／ｍより大きいと、トウが太くなるため、開繊によりさらに太くなり、取り扱いにくくなる。また、この炭素繊維トウを常法により開繊することで、糸幅を通常１０～４０ｍｍ、好ましくは１６～４０ｍｍ、特に好ましくは２０～４０ｍｍに調製する。この開繊の際も、できるだけ繊維にダメージを与えないようにするために前記のような梨地仕上げした開繊バーを使用するのが望ましい。更に、開繊した炭素繊維トウを　通常、炭素繊維を製織する際に使用することができる織機、例えばシャトル織機やレピア織機等を使用して製織し、平織あるいは朱子織の織物とする。

【００１１】以上のようにして得られた本発明のピッチ系炭素繊維織物は、ＦＡＷが５０～５００ｇ／ｍ^2、好ましくは８０～４００ｇ／ｍ2、特に好ましくは１００～３００ｇ／ｍ^{2}であり、目開き割合が１０%以下、好ましくは５%以下、特に好ましくは３%以下である。なお、ここでの織物の目開き割合とは、織物を該織物の平面に対して垂直方向から見たときの、製織した炭素繊維トウのトウとトウとの隙間で、経方向の隙間と緯方向の隙間の重なった部分の割合である。

【００１２】

【実施例】以下、本発明を実施例により更に詳細に説明するが、その要旨を越えない限り以下の実施例により限定されるものでない。なお、実施例での織物の目開き割合の測定は、（株）ニコン製ＬＵＺＥＸ２Ｄにより画像処理を行って求めた。具体的には、目開き割合を測定しようとする織物の画像を取り込み、織物のある一定の面積に対する、目の開いている部分の面積の割合を求める。織物の画像を取り込んだ際、目の詰まっている部分と、目の開いている部分の色調が異なっているため、容易に割合を求めることができる。

【００１３】実施例１

コールタールピッチより、軟化点３００℃、且つ偏向顕微鏡下１００倍で観察した光学的異方性割合が１００%の紡糸ピッチを調整した。該ピッチを、口金温度３３５℃で溶融紡糸し、得られたフィラメント数１２０００のピッチ繊維トウを得た。該ピッチ繊維トウを３８５℃で空気中で加熱処理することにより不融化繊維トウを得た。更に、該不融化繊維を梨地処理したガイドバー及びコムに通しながら２１００℃で黒鉛化し表面処理した後、エポキシ系のサイジング剤を２%添着し、炭素繊維トウを得た。かくして得られた炭素繊維トウ繊度は２．０ｇ／ｍ、糸幅７ｍｍであった。

【００１４】該炭素繊維トウを梨地処理した開繊バーを用いて、糸幅２０ｍｍになるよう開繊した炭素繊維トウをレピア織機にて製織した結果得られた平織の炭素繊維織物はＦＡＷ２００ｇ／ｍ^2、目開き割合２%と欠陥のないものであった。この炭素繊維織物にエポキシ樹脂を含浸してプリプレグを作成した後、積層し、１２０℃で２時間熱処理をして成形してＣＦＲＰを製造したところ、欠陥がなく、引張強度が約４０ｋｇ／ｍｍ^{2}と充分な強度を有したＣＦＲＰが製造できた。また、この炭素繊維織物にフェノール樹脂を含浸してプリプレグを作成した後、成型し、成型体を得た。この成型体を２０００℃で焼成した後、ピッチを含浸し、９００℃で１時間焼成する緻密化工程を７回繰り返した。これを２０００℃で焼成することによりＣ／Ｃを製造したところ、大きなボイドを有することのなく、また、良好な強度を有したＣ／Ｃが得られた。

【００１５】比較例１

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実施例１と同じ炭素繊維トウを開繊せずに製織し、ＦＡＷ２００ｇ／m^2、目開き割合５０％の平織りの織物を得た。この炭素繊維織物を用いてＣＦＲＰを製造したが、大きな空隙ができ、また、実施例１のＣＦＲＰの４分の１程度の引張強度であった。

【００１６】比較例２

実施例１と同じ炭素繊維トウを開繊せずに製織し、ＦＡＷ５４０ｇ／m^2、目開き割合１０％の平織りの織物を得た。この炭素繊維織物を用いてＣＦＲＰを製造を試みたが、樹脂含浸がうまくいかなかった。

【００１７】比較例３

実施例１の黒鉛化工程で、梨地バーの代わりに鏡面のバーを用いた以外は実施例１と同じ方法で製造した炭素繊維トウを得た。このものを、開繊処理したところ、ケバ

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の発生や、フィラメント切れにより、製織が困難であった。

【００１８】

【発明の効果】本発明のピッチ系炭素繊維織物は、太く糸幅の広い炭素繊維トウを用いて製織されているため凹凸が少なく、織糸間の空隙が殆どないという特徴を有し、且つ、安価に製造することができる。かかる炭素繊維織物を用いることにより、欠陥が少なく、非常に高い強度特性を有するＣＦＲＰやＣ／Ｃなどの複合材を得ることができる。該複合材の具体的用途としては、例えば、優れたガス透過性、電気伝導性、機械的強度を有する点で、燃料電池用の炭素電極材としての応用が期待できる。

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